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Scientists, especially, should read the book, if for no other reason than to convince themselves how metaphysical their scientific hypotheses are.

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*Essentials of College Botany.* By CHARLES E. BESSEY, Professor in the University of Nebraska, and ERNEST A. BESSEY, Professor in the Michigan Agricultural College. American Science Series. The eighth edition revised and entirely rewritten. Henry Holt & Co. 1914. Pp. xiv + 409 with 206 illustrations.

The authorship of this essentially new book is unique in American botanical literature, and as a fitting foreword it is a pleasure to recall that the senior author has spent over two score of years in the constant and very fruitful pursuit of botany. The junior author, the son, was therefore reared in an invigorating atmosphere of phytology, since which he has been at the head of the department of botany in the Michigan Agricultural College, the very place where the father began, as an undergraduate, the serious study of the subject conjointly expounded in this text-book fresh from the press.

As a winning football team is sometimes built up around a star player, so here it is quickly noted that the book in hand has a dominant feature, namely evolution, and its title might well be phytophylogeny. In other words in the groundplan one sees fourteen phyla (branches) of the vegetable kingdom arranged in the order of the probable appearance of their members (species) in point of geologic time. The senior author has long specialized in taxonomy, publishing his results from time to time in pamphlet form, as, for example, "A Synopsis of Plant Phyla" (1907), and now the botanical world welcomes the appearance of the present work in which phylogeny is made the keynote of a text-book.

The phylum is the group unit employed for expanding the fundamental doctrine of evolution, namely, that the first species were low plants and from them have evolved all

others, thus making all species genetically related, whether far or near, low or high. The lowest of the fourteen phyla is the myxophyceæ (slime algæ)—(the slime fungi find no place in the plant kingdom), and ends with anthophyta (flowering plants). Each phylum has its separate chapter, in which the dominant feature is considered through "laboratory studies" of types followed by a short bibliography. Thus, for example, "phylum V., phæophyceæ—the brown algæ" has for its characteristic idea the addition of the brown pigment, with which certain structural features are associated. This phylum is a lateral divergence from the main evolutionary stem. Again "phylum VIII., bryophyta—the mosses," is derived from the Chlorophyceæ (simple algæ), shows (a) obvious alternation of generations, (b) beginnings of conductive tissue and (c) the members grow upon land. "Laboratory studies," as usual, are given under the classes, namely, liverworts and mosses.

The last chapter, and last phylum, deals with anthophyta (flowering plants) and includes more than a half of all known plant species. In the laboratory the pupil will here receive the instruction that usually is found in the early pages of the less modern text-books. This chapter closes with a tabulation of the "greater steps" in the development of the highest from the lowest plants.

While the method here followed is logical from the evolutionary viewpoint, as a matter of fact many pupils get into college seriously deficient in botanical perspective, and therefore a few preliminary lessons upon the more evident parts of the higher plants and something of their functions would be advantageous before "making the plunge" into the depths of protoplasm, the most complex of all substances when measured by its boundless activities and possibilities. Therefore it might not be a crime to begin the class with a portion of this last chapter, thus bringing the pupils even by way of review in closer touch with the worldwide out-of-door botany. Next to kinship is social relations, and one wishes that the pupils might be introduced to plant societies, that is, to the environmental factors, namely, ecology,

but that is, perhaps, too far afield for this work, and a companion to it upon field botany may follow.

Concerning the fourteen phyla it is evident that number of species is no criterion as, for example, the calamophyta with its twenty-four existing species, in a single genus of insignificant plants, stands in the same grade of groups with anthophyta with its 132,000 present-day species. The authors state that "philosophically a phylum originates with the incoming of a new idea. Stated structurally, it has its beginning with the development of a dominant morphological peculiarity. Stated taxonomically its initial point is indicated by the appearance of a new character." So long as the "new character" dominates the phylum remains, but later "ideas" may be expressed, and when they become dominant new phyla arise successively, and thus the phylogenetic tree is built up. It is evident that there might be some difficulty in securing the weights of new ideas in the scale pan of phylogeny, determine the dominance of a "morphological peculiarity" and the appearance in time of a "new character"—all of phylum grade, and therefore so long as the personal equation plays its rôle the last shift in the phylogenetic scheme is not yet made.

The "Key to the Phyla of Plants" follows directly upon the fourteen phylum chapters, occupies fifty pages, brings the classification down through classes, orders to families and under these last 683 groups illustrative genera are named. This feature of the book is closed with reproductions of wall charts showing in one the relationship of the phyla and in the other those of the orders in the anthophyta. These charts will be of great help in genetics and perhaps the publishers may be induced to issue them in large size for classrooms. It is a pleasant thought that these charts, when reduced to page size, suggest at first glance the forms of certain species of algæ and fungi.

The early chapters remind one of the first edition, particularly those upon "Tissues" and "Tissue Systems." More space for greater elaboration seems advisable here, and the single chapter upon physiology needs ex-

panding to three upon nutrition, growth and reproduction, respectively, with possibly one upon pathology—a subject that nowadays can not be adequately treated in four small pages.

Chapter V. "The Chemistry of the Plant" is an assemblage of the plant constituents with their formulæ and occurrence. These pages do not admit of use as either text or laboratory studies, and would make an appropriate appendix, possibly associated with a similar grouping of phytophysical facts and principles.

Twenty-nine pages of index "speak volumes" for the book.

It is a matter of regret that in a text-book where evolution is the fundamental thought the subject of species-making is not presented somewhat fully and even historically in outline. Under the topic "Variations" both "natural selection" and "Mendelism" are touched upon and "mutations" barely mentioned. It is judged that the authors are essentially Darwinians who strengthen their book by frankly stating their ignorance of the way "inherited variations" arise. They are equally wise with their "we do not know" in other places in the text.

As a general criticism, previously hinted, the book seems too small for its contents. The tendency to list instead of to elaborate is felt, due doubtless to a fixed limit of space set by the series of which it forms a unit. The authors have done their work admirably under the pressure, and it is regrettable that the publishers are sometimes at fault. Fanciful colored pictures that inflame the imagination are not asked for, but clear photo- and line-engravings that supplement the text are demanded. Many of the illustrations are too small and "inky"; for example, those under physiology, and give the pages a "pinched" appearance. Even the full-page phylum charts require a reading glass, in parts, for their use. The proof-reader fails at times as in uniformity of type for botanical names of plants (*e. g.*, p. 53).

Botanical teachers and taxonomists and paleobotanists as well, can not but feel deeply thankful for the appearance of this new text-book differing from others in its point of view

and setting down in a concise and clear form the results of many years of very successful study and teaching of the subject presented. It may well become a new starting point for editions that should take on the size and type of illustration that the dignity of a college botany deserves. Here is a hearty welcome to the new text-book in phytophylogeny—The Besseys' Botany Book of Branches.

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October 28, 1914

*Botanical Features of the Algerian Sahara.*

By WILLIAM AUSTIN CANNON. (Publication No. 178, Carnegie Institution of Washington. 1913. 81 pages, 36 plates.)

The journey of which this paper is an account was made in order "to examine the more obvious features of the physiological conditions prevalent in the region in question and, in connection with these observations, to make some detailed studies of the root-habits of the most striking species of the native flora."

After introductory chapters on the geography and climate of Algeria, the writer proceeds with an itinerary of his trip through the desert. This portion of the paper contains a great deal of topographical detail, together with much that is of directly botanical interest, although presented in a somewhat desultory way. The important botanical data are treated more systematically in the "General Summary and Conclusions" (pp. 66-81).

The author's intimate acquaintance with the vegetation of the southern Arizona deserts makes his comparison of conditions there and in the Algerian Sahara of special interest and value. Some of the striking points of difference as summarized in the concluding paragraphs are: (1) the greater sparseness of the Saharan vegetation, as compared with that of Arizona, there being "probably no large area in southern Arizona, where the soil conditions are favorable for plants, where the water conditions are too meager to support a perennial flora of some sort. The greater aridity of the northern portion of the Sahara is evident,

therefore, from the great contrast in its flora." Cannon therefore suggests the term "semi-desert" for the Arizona region in contrast with a true "desert" like the Algerian Sahara. (2) The smaller size of the individual plants, at least of the perennial species, in the Sahara. (3) The smaller development of spines. "What may be the proportion of armed to unarmed plants in the northern Sahara I do not know, but to a person familiar with the plants of southern Arizona, where spinose forms are very numerous, the Algerian plants do not appear especially well protected."

Attention is also called to the fact that while in the Arizona desert there are numerous species, among the Cactaceæ and other families which have a "water balance," *i. e.*, which during and immediately after rains store water in their tissues, to be drawn upon in periods of drought; few examples of this adaptation were met with in the Algerian Sahara. Cannon correlates this scarcity of "water balance" plants with the fact that in Algeria there is but one rainy season. He notes that in the Tucson region, where such plants are numerous, there are two rainy seasons during the year, while in the desert region farther west, where but one well marked rainy season occurs, succulent plants are few or wanting.

The author's studies of the root habits of desert plants in Arizona led him to devote especial attention to this feature of the Saharan vegetation. The results of his investigations are summed up as follows: "A study of the relation of the root-type of the Algerian plants to the plant's distribution leads to the same general conclusion already obtained by similar but more extended study in the Arizona desert, namely, that the connection is often a very close one and often of definitive importance. Where the root-type is an obligate type the distribution of the species is much restricted, but where it undergoes modification with changed environment the distribution of the species is much less confined. It is of interest to note especially that as a rule it is the latter kind of root system that is developed by such plants as occur where the soil conditions are most arid, that